Educational Performance of ALN

Via

Content Analysis

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Abstract

This research suggests that learning in the ALN mode can be adequately described by the Social Interdependence Theory of Cooperative Learning. The ALN is an *enhanced positive interdependent cooperating group* of participants.

Learning of N participants in an ALN mode can be described by a set of 4N+4 processes. Each of the participants is engaged in 2 sets of 2 processes each: The *learning processes set*, consisting of the **Reasoning Input process** and the **Learning-Control Input process**, and the *support processes set*, consisting of the **Social Input process** and the **Response Input process**. Each participant cooperate with the ALN group, which can be described as an abstract entity that reciprocate by providing services via the corresponding (virtual) 4 *Services processes*: The **Reasoning Service process**, the **Learning-Control Service process**, the **Social Service process**, and the **Response Service process.** Following findings of the Social Interdependence Theory of Cooperative Learning, it is argued that these processes can be maximized in an ALN mode of learning.

We present a methodology for the evaluation of the performance profiles of the ALN educational Services processes and of the participants' Input processes. This methodology is based on identifying level distributions of the processes' performance via content analysis of the information flows exchanged between the participants. The methodology is demonstrated on a 3 weeks Asynchronous Discussions embedded in an ALN course of the Open University of Israel.

The performance profiles could be used for quality control management of the ALN. Weak performers could be identified and communicated via private, back door communication channel such as email. A more ambitious program is to establish sets of standard performance levels - 'acceptable' and 'alarm' levels - that will serve as key features in components of ALN management system.

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I. Introduction

Open University of Israel

The Open University of Israel (OUI)[3] was established 25 years ago. It provides 400 courses to 40,000 (part time) students via Distance Learning methods. The University was modeled after the British OU: Learning was a mix of individualized learning (based on pre-prepared packages of learning materials), with a substantial support of face to face tutorials, telephone consultations and one way television broadcasting.

In 1992 this author suggested that the Open University should explore for ways of incorporating the (then) emerging telecommunication technologies into its teaching and learning environment. A University wide task force was established and following its recommendations an experimental project (directed by this author) - TEle LEarning Methodologies (TELEM) was set up, with the goal of identifying the benefits of asynchronous learning and methods of its implementation. This project was later expanded into The Center for Information Technologies in Distance Learning, of which TELEM is one department. The Center is in charge of exploring benefits of learning methodologies that employ variety of information technologies, Asynchronous and Synchronous, and of introducing them (the technologies and the methodologies) into the courses of the OUI. TELEM focuses on Asynchronous Learning Networks (ALNs). Currently about 80 courses include Internet based technology support (Web sites, email and asynchronous forums). 10 courses include Synchronous Technology support (satellite based interactive communication: one way video, two way audio) as well. The plan is to introduce asynchronous technology into most of the 400 courses in the next three years.

Goals of this research:

The primary difficulty in diffusing the usage of ALN and other technologies into the fabric of OUI courses was - and still is - the lack of clear understanding of the educational benefits of doing so. Theoretically, the ALN mode of learning enables a variety of enhanced cooperative activities. Theoretically, then, it enables students to acquire benefits that seem to be hard to acquire with other modes of learning. Deep, time consuming reasoning processes, for example. These ideas have to be developed, researched, and refined within a solid educational theory, and tested, so that a cost-benefit analysis could be performed. Members of the Center are engaged in such research. This work aims at identifying educational benefits that can be maximized with ALN mode of learning, incorporate them into an (existing?) educational theory, developing a methodology for assessing the actual levels of achievements of these benefits, and demonstrating the methodology in a real ALN situation.

The course:

The course that served as a test-bed for this research was the Open University course *20391 Computer Mediated Communication and Distance Learning* provided in 1995 and analyzed in 1997-1998. This course is a senior year, small group, seminar type course, an elective in the B.A. in Computer Science program. It was specifically established with a view of using it as a test-bed for research. The course was available in one integrated (mostly asynchronous) form, described below, in section IV. The intended audience were Computer Science undergraduates,

[3] http://www-e.openu.ac.il

towards the end of their studies (Computer Networks course was a prerequisite) who were specifically interested in Computer Mediated Communication, from both the technical and educational views.

II. Rational

The primary motivation for creating this research, was the wish to understand the educational benefits of ALN. For this end we searched for suitable educational-benefits candidates and an appropriate theoretical framework and developed a methodology for evaluating the achieved benefits. In order to demonstrate the feasibility of the methodology, we designed and carried out an ALN course that served as a test-bed. The theoretical foundation is described in section II.A, the educational benefits (certain learning processes) are described in section II.B, and the evaluation procedure in section II.C.

II.A Conceptual Framework: The Social Interdependence Theory of Cooperative Learning

"*Asynchronous Learning Networks (ALN) are people networks - learning anywhere*" [**1**]. The key characteristic of the ALN model is the capability of its learners to be a part of a community, cooperating asynchronously to achieve a common goal: learning [**1**], [**2**]. Typical implementation of the ALN model is a group of participants (learners, tutors, experts, technicians, and lecturers) supported by a distributed computer system that includes information servers (WWW, ftp, library), their associated clients, and multi-way communication software: electronic mail and conferencing system. For a detailed example, see [**3**]. For a recent discussion about the policy issues, functional requirements and practical issues see [**4**], [**5**], and [**6**], respectively.

Hiltz and Turoff [**7**] pointed out that the educational value of an ALN should measure the educational benefits to the learner. Moonen [**8**] noted that a critical factor in a cost effectiveness analysis of ALN is the effective usage of the relatively long, contact time of the learner with the ALN environment. The perceived effectiveness of the ALN determines its usage by the learner. Earlier studies [**9**] show that learners perceive the content of communication as an information resource. But the benefits of ALN go beyond the accumulated knowledge. It is the process of construction of the shared body of knowledge that is valued in the constructivist learning theory [**10]**. This process includes a rich set of cooperative educational communication patterns: Questions and answers, guided tutoring, announcements, concurrent multithreaded discussions, voting, competitions, etc. [**9**]. This observation brings up the hypothesis, that learners in the ALN mode gain additional educational benefits from the ALN: they engage in a set of high level critical thinking processes.

Focused studies identified some sets of these educational benefits. Mcreary [**11**] and Newman et al [**12**] pointed out that certain critical thinking processes, such as reasoning, benefit from the ALN. Henri [**13]** added to that set the meta-cognitive processes with which the learner reflects on the overall learning activity. Wegerif [**14]** emphasized the social support benefit of the ALN. Hiltz and Turoff [**7**], Ellis and Mcreary [**15**], Harasim [**16**] and others identified the peer to peer interactivity, or the responsiveness benefit.

These observations fit well with the Social Interdependence Theory of Cooperative Learning (see Johnson & Johnson [**17**] for a complete description). Briefly, this theory suggests that the way social interdependence (of group members) is structured into the learning environment determines how individuals interact, which, in turn determines the learning outcomes. Learning is structured cooperatively (positive interdependence) when individuals' goals achievements are positively correlated, i.e. individuals perceive that they can reach their goals if and only if the others in the group also reach their goals. In this case individuals seek outcomes that are beneficial to all those with whom they are cooperating. This type of interdependence (as opposed to competition or to individualized learning) results in promotive interactions: actions of individuals substitute for each other, participants positively invest energy to support each other action and there is high degree of openness among participants. This results in a large variety of educational outcomes that are classified into the categories of *High Effort to Achieve*, *Positive Interpersonal Relationships* and *Psychological Health*. These outcomes influence each other. Numerous experiments, performed in the last 100 years, provide a sound ground to the validity of this theory and it findings. For a comprehensive review, see [**18**].

Three findings of the Social Interdependence Theory are of particular importance for ALN studies. The first is in the High Efforts to Achieve category: *Cooperative Learning promotes a greater use of higher level reasoning strategies and critical thinking than do competitive or individualistic learning strategies* [**19**], [**20**], [**21**]. This finding is correlated with the fact that *cooperators spend more time on tasks then competitors or students working individualistically* [**18**]. Since ALN provide for substantial extension of think time, it is reasonable to assume that high level reasoning and critical thinking processes can be maximized in asynchronous learning.

The two other findings are in the Positive Interpersonal Relationships category. *Social Support* is the degree of exchange of resources intended to enhance mutual well –being and the existence and availability of people on whom one can rely for assistance, encouragement, acceptance and caring [**17**]. By *Peer Feedback* (or *responsiveness*) individuals in the group learn from each other how they perform on a given effort. It was found that *Cooperative experiences tend to promote greater social support than did competitive or individualistic efforts* [**18**], and in addition, *Stronger effects were found for peer support than for superior (teacher) support*. What is important is that achievements (e.g. critical thinking processes) and positive interpersonal relationships (social support and responsiveness) are reciprocally related [**18**].

In the ALN environment the bandwidth of communication is narrow (very little or no face to face meetings) and the (written) communication comes in delayed bursts. Social support and responsiveness processes are not easily maintained here – they have to be specifically, intentionally integrated into the learning environment. The ALN is an enhanced (extended think time) *positive interdependence cooperating learning group*, which has to be specifically structured with Social and Responsiveness processes in order that the high level Critical Thinking (i.e. learning) processes could be maximized.

II.B Educational Benefits of ALN: Service and Input processes

The group of participants in an ALN can be thought of an abstract entity, peer of the individual learner. This entity learns the subject matter, knows how to socialize, to respond to learner queries, and to provides critical thinking. It provides **Educational Services**, carried by group **processes** to the learner, which encourage him (or her) to reciprocate by the corresponding individual **Input processes**. Using the Social Interdependence Theory of Cooperative Learning we identify two sets of theses Services & Input tandem processes: Support processes, and Learning processes. Support processes are required for creating and maintaining the cohesive responsive cooperating *group* of participants. These include the **Social process** and the **Response process**.

Maximizing Learning processes is the goal of the ALN group. The learning Services (group) processes are required for triggering and maintaining the reciprocal individual learning processes of the individuals. The Social Interdependence Theory of Cooperating Learning identifies at least one such tandem processes: The **Critical-Thinking Services & Input processes.** These exhibit a set of cognitive and meta-cognitive skills and knowledge of the ALN and the individual. We follow Henri[**13**] by dividing this set into two subsets of processes. The (tandem) **Reasoning processes** (the cognitive processes) and the (tandem) **Learning-Control processes** (meta-cognitive processes).

The learning activity of an N participants ALN consist, then, of 4N individual **Input processes**, and 4 group **Service processes**. The ALN is a positive interdependence structured cooperating learning situation, and therefor all these processes are strongly correlated. Each of the processes is performed at a certain level, at any point in time. These levels are described next.

The tandem **Social processes** provide group cohesiveness. These processes move the learner to cross the threshold from "outsider" status to "insider" [**15**]. Each of these processes can be performed at two levels, *Social Value*, or *No Social Value*. It either exist or not.

The tandem **Response processes** provide the content-relevant communication between the learner and the group. Winiecki [**22**] presented strategies for reconstituting conversational practice into ALN that can improve participants' ability to "keep the thread" of the discussion. The Social Interdependence Theory makes a distinction between peer responses (learner to learner) and learner to Tutor responses. At the lowest level, group communications do not relate any learner's specific needs. Otherwise the processes respond to the Tutor, or, at the highest level, to the learner.

The tandem **Reasoning processes** exhibit skills and knowledge that are on par with those at work in problem resolution [**23**]. Reasoning Service & Input processes perform, then, at 5 levels, described next. These levels correspond to the learning hierarchy suggested by Biggs [**24**].

Reasoning at the *Simple Clarification* level means identifying problem elements, and their linkages. *Deep Clarification* provides more details about beliefs or assumptions that underlie the statement of the problem. *Inference* means problem solving via induction, deduction, or another problem solving methodology (e.g. algorithm). Reasoning at the *Judgement* level means making decisions, appreciation, evaluations and criticism of content related issues. Reasoning at the *strategy* level proposes a plan for attacking the problem.

The **Learning-Control processes** exhibit the ALN group and the individual meta-cognitive skills and knowledge of reflecting on their own or their peers' teaching and learning activities. This is reasoning about reasoning. These reflections can, for example, identify weaknesses in learning methods, or wrong strategies, which could lead to changing of the learning processes or seeking for support. The long-range impact of these processes on the learning processes is emphasized in several educational theories. Biggs [**24**] puts them on the top-level hierarchy of learning activities. Learning-Control process perform at the *Evaluation* level when it assesses or verifies its own or peers' learning processes. It performs at the *planning* level when it sets steps and plan learning process, and at the *regulation* level it supervise (its own or peers') learning processes, and changes them.

The set of educational processes and their possible levels are presented in the **Table 1**.

Table 1: Educational Service & Input Processes

Support processes		**Learning processes**	
Social process	**Response process**	**Reasoning process**	**Learning-Control process**
Levels of performance			
NoSocialValue	*NonResponsive*	*SimpleClarification*	*Evaluation*
SocialValue	*ResponseToTutor*	*DeepClarification*	*Planning*
	ResponseToLearner	*Inference*	*Regulation*
		Judgement	
		Strategy	

II.C Evaluation performance by content analysis

The educational Services processes of an ALN reciprocate the educational Input processes of the participants. As early as 1991 Mason [**25**] suggested that performance levels of educational processes could be evaluated by content analysis of the messages exchanged between these processes. Henri [**13**] suggested an analytical method for

extracting the performance levels of participants from the content of the information flows in the ALN. "*Thus informed*", writes Henri, "*the educator is in a position to fulfil his main role, which is to offer immediate support to the individual and the collective learning process*". Bonanno [**26**] evaluated communication patterns of participants in an ALN via content analysis of the messages. More recently, Newman, Webb and Cochrane [**12**] performed an extensive one-dimensional (the depth of critical thinking dimension) comparative content analysis of face to face course versus ALN course. They found that group learning in either of these environments provide similar depth of critical thinking.

The information flow created by a participant in a cooperative learning scenario consists of 4 sub-flows contributed by the participants' Input processes. The performance of each of these processes is described by an **Educational Performance Profile**, which is the distribution of this process-levels exhibited in the sub-flow. The performance of a participant is, thus, described by a set of 4 **Educational Performance Profiles**. For example, participant 7 might be characterized with a **Reasoning Input Performance profile** equal to (0, 25%, 30%, 45%, 0); The input information flow of this participant provides a reasoning sub-flow consisting of 25% *DeepClarifications*, 30% *Inferences*, 45% *Judgments*, but neither *Strategies nor SimpleClarifications.* This information flow was created by the **Reasoning Input process** of participant 7.

The performance of the ALN group is described by a similar set of 4 **Educational Service Performance profiles**, which are the distributions of the group process-levels in the corresponding sub-flows of the total ALN information flow.

In this work we follow the ideas presented by Henri [**13**]. Specifically, the input information flow of each participant in the ALN as well as the total information flow of the ALN is quantized into Information units - each has a unit of meaning. Each Information Unit is then associated with (sub-flow, level) pairs. This association is based on the identification of appropriate identifier-statements in the Information unit. The identifier-statements are defined by a set of operational rules. These operational rules are listed in tables 2 - 5 below. This analysis identifies the sub-flows of each participant and of the ALN as well as the relative intensities of the performance levels exhibited in each sub-flow. These relative intensities are the Performance profiles.

Table 2: Identifying levels of **Social process** sub-flow

level	identifying statements in an information unit
NoSocialValue	No socializing comments. All statements relate to the formal subject matter.
SocialValue	Socializing comments unrelated to the formal subject matter.

Table 3: Identifying levels of **Response process** sub-flow	
level	identifying statements in an information unit
NonResponsive	All statements do not include a response (but are relevant).
ResponseToTutor	Respond to a message(s) sent by an educator.
ResponseToLearner	Respond to message(s) sent by another learner.

Table 4: Identifying levels of **Reasoning process** sub-flow	
level	identifying statements in an information unit
SimpleClarification	Study a problem under discussion - identifying its elements and observing their linkage, leading to basic understanding. Examples of such statements include identifying previous stated hypothesis and reformulating the problem.
DeepClarification	Shed more light on the assumptions, beliefs and relations related to the problem. Examples of such statements include identification of the (otherwise hidden) assumptions and identifying needed information.
Inference	Make inferences, deduction and induction, linked to previously proposed ideas.
Judgement	Make evaluation, appreciation and criticisms of ideas expressed in other messages.
Strategy	Propose set of possible solutions and actions that lead to the identification of their relevance to the problem at hand.

Table 5: Identifying levels of **Learning-Control process** sub-flow	
level	identifying statements in an information unit
Evaluation	Assess one's knowledge and skills of chosen strategy.
Planning	Put up an organizational, procedural plan of the work that has to be done.
Regulation	supervise and maintain the overall task

III. Background information for the course

At the end of 1994 there were virtually no ALN courses at the OUI. Several courses (in Computer Science) started to incorporate electronic mail for simple tutoring and delivery of assignment. The first course that was specifically designed with ALN mode of learning, as a primary mode was the *20391 Computer Mediated Communication and Distance Learning* designed and delivered by this author. This was a 17 weeks (one semester course), which included 3 one-week asynchronous discussions, which served as the test-bed for this research. 10 students, one tutor (this author) and one technician participated in the course and the discussions.

Students were undergraduates majoring in Computer Science, just before the end of their academic program (they all had Computer *Networks* course - a typical end-of-the program course, before taking this course). As is usual in Israel and in particular at the OUI, these were mature students (all above 25. All were working in addition to their studies). Their grades were (this was found after the course) average and above. Two students - in addition to the 10 - started the course but left right at the beginning. This was due to the intensive workload and the particular topic of this course. All students were experienced Internet users, and, of course, very experienced in using computers, but none of them had any previous experience with ALN. The course was an elective, targeted to Computer Science students with special interest in education. There was no set goal for the number of students, but as it was intended that it will serve as a test-bed for researching cooperative learning, it was expected to undertake about 15 students.

IV. Method

IV.A Technology and Infrastructure

Hardware/Software:

Each student used his PC, from home. This included windows software or Unix, with TCP/IP or Terminal Emulation over dial-up. We supported all the four platforms. The Open University served as the Internet Service Provider. A Unix workstation (SUN SPARC) at the Department of Computer Science of the Open University provided a set of Internet server-processes. No commercial applications were used. For those who did not have TCP/IP or Terminal Emulation software on their PC we provided a public domain version.

Electronic Delivery Mode:

Most of the communications (email and NewsGroups) were text-based. No streaming media was used.

Management of Infrastructure:

The Network Administrator of Computer Science managed the technical infrastructure - servers, networks, etc. in house.

IV.B Content Delivery

Delivery:

All course materials, definition of assignments, the work schedule and the descriptions of the Asynchronous Discussions, were delivered to the learners at the beginning of the course. Handing in assignments and all other transactions (questions, advice, work exchange, discussions, etc.) were done electronically, via asynchronous communication.

Detailed, tight and intense works schedule, was prepared and delivered to the students at the beginning of the course. This covered the whole series of ALN activities, including the interleaved sets of series of individualized learning, face to face tutorials, Internet search and retrieve activities, team projects and the asynchronous discussions. The works schedule is listed in the next paragraph.

Structure:

20391 Computer Mediated Communication and Distance Learning course was an integrated course. It included static information resources - a monograph [9], study guides, and Research papers, and dynamic resources from the Internet. It included synchronous (face to face) meetings (3: one at the beginning, one in the middle - after the first asynchronous discussion, and one at the end), but most of the communication were asynchronous - via electronic mail and newsgroups. It included individual works and cooperative projects, including the three one week asynchronous discussions. The workflow of the course is described in the following box:

Face to face meeting: Introduction, technical issues, goals, and explanation about modes of learning. (First day of course).

Repeat 3 times

- Background readings: Text. Assignment; **Individualized work** (1 week)
- Exchange assignments between learners, send comments: **group interaction**
- Additional Reading: Internet; Assignment; **Individualized work** (1 week).
- Exchange assignments between learners, send comments: **group interaction**
- Background readings for the discussion: text; Send summary to Tutor; **individualized work**; (2 week)
- Asynchronous Discussion; **group work** (1 week)
- **Face to face** meeting (only after first Asynchronous Discussion)

Project; **group work** (Last two weeks)

Face to face meeting, including project presentations. (Last day)

Each of the asynchronous discussions had the same format. Assigned background literature was read in the two weeks prior to the beginning of the actual discussion. These were summarized by the each of the students (and to be sure, copies were sent to the Tutor before the discussion). At the beginning of the Asynchronous Discussion (Saturday night) the Tutor broadcasted two focused questions on the specific NewsGroup allocated to this

discussion, and assigned three students as "panel members". From there on the discussion continued on the NewsGroup (and on other NewsGroups allocated for technical or administrative issues). The role of the panel members was to keep the thread going, by questions, remarks etc. At the end of the week (Friday afternoon) the Tutor - who spent most of the week on-line, but with minor interventions - summarized the discussions.

The Asynchronous Discussions were structured to *positive social interdependence* [17]. The class was a **formal cooperative learning group** that lasted for 17 weeks. The **academic objectives** - maximizing performance in Reasoning and Learning-Control, and the associated **social objectives** - maximizing performance of the Social and Response processes - were identified. These are, of course, interdependent. Learners were assigned **encourager-roles** (panel members), on a rotational basis. The course included **materials interdependence** - materials that initially existed in one copy only (the summaries created by the individuals that were later exchanged between them and commented upon by their peers, and the information flows in the Asynchronous Discussions). Finally, the **level of personal success** (which partially determined the grade) in the Asynchronous Discussion was set to: *The degree of triggering others to provide Learning processes.* This structure was explained to the learners in the first face to face meeting and was discussed later in a side administrative NewsGroup. (To be precise: the fact that **Learning Processes** meant **Reasoning and Learning-Control** was not specified initially. Revealing this was part of the learning in this course). A special feature of the Discussions (and, indeed, the whole course) was its recursive nature: The learning methods discussed in the course were used during learning.

Evaluation of students performance in the course:

30% Asynchronous Discussions, 30% assignments, 30% project, 10% presentations.

Face to Face meetings:

1. (First day of course) Organization, Technical issues, forming *positive interdependent group*
2. (After first Asynchronous Discussion): Evaluation of the Discussion Mechanism, Forming teams for project, explanations about the project.
3. (Last day of course) Students' presentations.

IV.C Organization and Evolution

Development Responsibility:

This author (a faculty member) was responsible to the development and delivery of the course.

Technical Support:

Technical support was provided on-line as well as by phone, and in the first day, by face to face meeting. It was provided by the System & Network administration of the Department of Computer Science. He was available at all

time - for Asynchronous Communications. Phone consultation times were predetermined. It was used only during the first weeks (mostly modem problems).

Budget:

Developing and running the **course** required about $70,000 This includes the salary of one faculty member for 7 months (3 months development and 4 months running the course) and the salary for a technician (1/3 for 7 months), including overhead. This was funded internally by the OUI - like every other course at the OUI (that is, by the Ministry of Education).

The cost of the **research** that used this course as a test-bed was $120,000. This includes 70% of the salary of one faculty member salary for a year, and the salaries for two part time (50% each) researchers, psychologist and a linguist (that did the content analysis) for about a year.

The major source of funding this research was the Multimedia Online Services and Technology (MOST) Consortium. This is an Israeli Industrial Consortium with support from the Chief Scientist at the Israel Ministry of Industry. The grant from this source was $95,000. The Open University provided complementary research grant of $25,000.

Schedule of course deliveries:

The course was delivered only once.

V. Results

The detailed interleaved sets of activities in the timetable, the carefully designed assignments, the particular background of the students and the topic of the course achieved active, vigorous participation in all the learning activities throughout the course on the part of the students (See also aviv, [**27**] for a detailed analysis of this point). This was amplified in the Asynchronous Discussion due to its positive interdependence structure. In this section we demonstrate this fact by presenting the performance profiles of the Asynchronous Discussions and the participants in the Discussions. These were calculated by the content analysis method presented in section II.C.

V.A Educational Services of an ALN

Fig. 1 presents the performance profiles of the ALN Service processes.

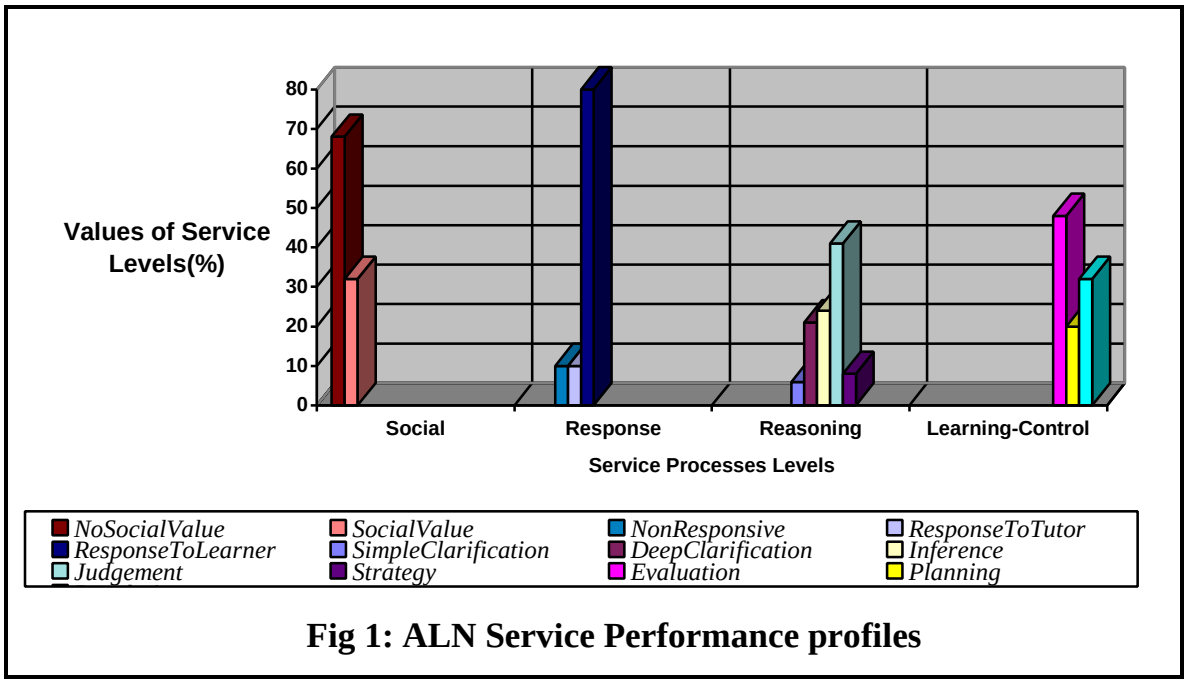

Fig 1: ALN Service Performance profiles

From Fig. 1 we see that the ALN group provided relatively high level of **Social Service** (30% of the information flow carried *SocialValue*). This high level of Social Service of the discussions enabled most of the learners "to pass the threshold", and created a cohesive group of cooperating learners.

The level distribution of the **Response Service process** shows that the ALN group was very strong in *ResponseToLearner* (80%) and low in its *NonResponsive* level. This means that the Asynchronous Discussions were fruitful debates, not a series of monologues. In addition, the Response Service was Learner Centered: most responses where from learners to learners, not from learners to tutor.

The level distribution of the **Reasoning Service process** shows that the ALN group provided large values of *Judgment, Deep Clarification* and *Inference*, and low values of *Simple Clarification*. In other words, this was a high level discussion. On the other hand there was little provision of *Strategy* in these discussions, which calls for a deeper analysis of the discussions' contents. It turned out that the discussion were about a theoretical issue (*Benefits of Communication Supported Learning*), so the group was not required to reach a particular goal or application.

Evaluation and *Regulation* were the predominant levels of the **Learning-Control Service process**. On the other hand, the ALN group was weak in *Planning*. This is in agreement with the patterns of Reasoning Service (strong in *Judgment* and *Deep Clarification* and weak in *Strategy*). Similarly, *Regulation* (monitoring and control of the cognitive activities) is usually correlated with high level cognitive processes.

V.B Educational Performances of individual learners

Fig. 2 presents the **Social Input Performance profiles** of the participants. We see that all the learner's inputs (except learner 7) provide relatively large, similar levels of *SocialValue*, despite the fact that their actual participation in ALN (Fig. 3), vary. In other words, these learners considered the discussion as a social event, independent of their actual participation or contribution to it.

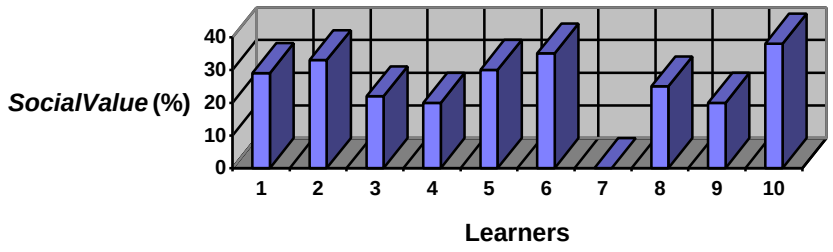

Fig 2: Social Input Performance profiles

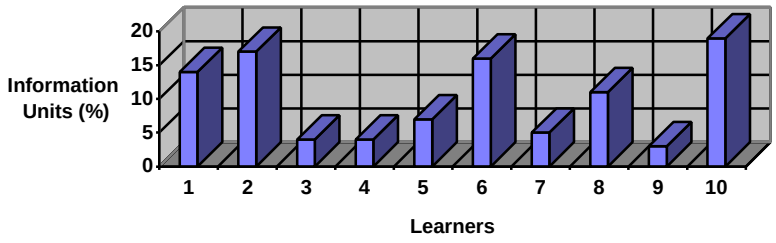

Fig 3: Relative Participation in the ALN

Turning to the **Response Input** (Fig. 4), **Reasoning input** (Fig 5.) and the **Learning-Control input** (Fig. 6) profiles we identify four group of learners. Learners 3 and 9 perform at low levels: their response has low levels of *ResponseToLearner*, their reasoning is mostly at the *Clarification* levels, and they exhibited negligible amounts of Learning-Control skills. We conclude that learners 3 and 9 are revealed as non-performers, technically as well as educationally.

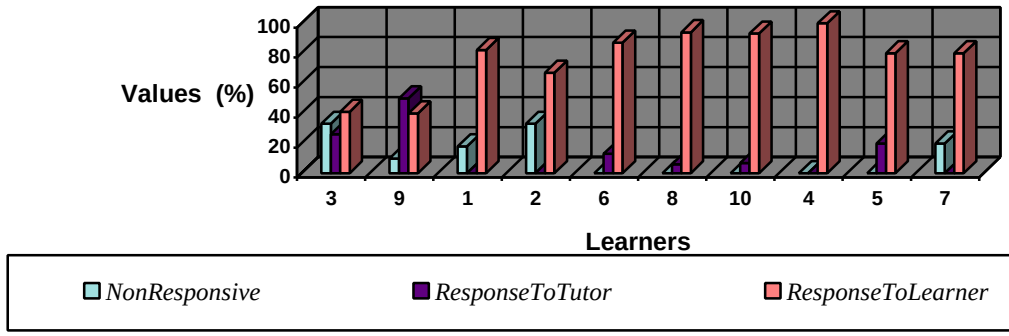

Fig 4: Response Input Performance profiles

The second group consists of students 1, 2, 6, 8 and 10. These students are assertive, socially connected, responsive, and communicate via the higher level reasoning and Learning-Control levels. The high levels of educational performance of these students determine the overall service levels of the asynchronous discussion.

High level educational performances are not necessarily connected to active participation. The third group, learners 4 and 5, participated less then those of the second group, but performed well in their response, reasoning and the Learning-Control inputs.

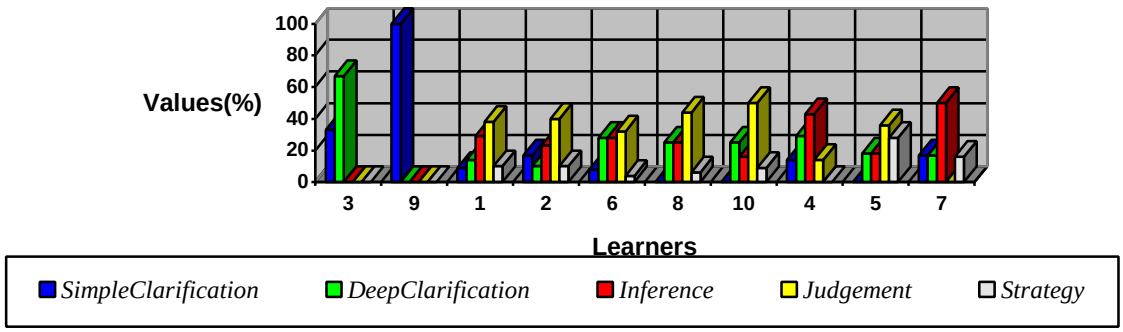

Fig 5: Reasoning Input Performance Profiles

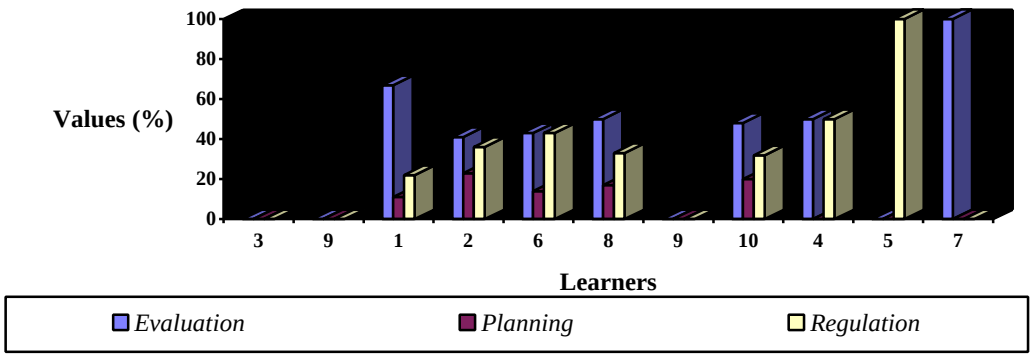

Fig 6: Learning-Control Input Performance profiles

These three groups of students performed well in their social input. Student 7 did not participate very much and did not contribute at all to the social strength of the ALN. This student performed extremely well in his (or her) reasoning and Learning-Control inputs. He was also very responsive to other learners. This is the smart guy that occasionally communicates, but other learners should be waiting to hear what he has to say.

VI. Conclusions and plans for further research

We suggest that learning in the ALN mode can be adequately described by the Social Interdependence Theory of Cooperative Learning. The ALN is an *enhanced positive interdependent cooperating group* of participants.

Learning of N participants in an ALN mode can be described by a set of 4N+4 processes. Each of the participants is engaged in 2 sets of 2 processes each: The *learning processes set*, consisting of the **Reasoning Input process** and the **Learning-Control Input process**, and the *support processes set*, consisting of the **Social Input process** and the **Response Input process**. Each participant cooperate with the ALN group, which can be described as an abstract entity that reciprocate by providing services via the corresponding (virtual) 4 *Services processes*: The **Reasoning Service process**, the **Learning-Control Service process**, the **Social Service process**, and the **Response Service process.** Following findings of the Social Interdependence Theory of Cooperative Learning, it is argued that these processes can be maximized in an ALN mode of learning.

We present a methodology for the evaluation of the performance profiles of the ALN educational Services processes and of the participants' Input processes. This methodology is based on identifying level distributions of the processes' performance via content analysis of the information flows exchanged between the participants. The methodology is demonstrated on a 3 weeks Asynchronous Discussions embedded in an ALN course of the Open University of Israel.

The performance profiles could be used for quality control management of the ALN. Weak performers could be identified and communicated via private, back door communication channel such as email. A more ambitious program is to establish sets of standard performance levels - 'acceptable' and 'alarm' levels - that will serve as key features in components of ALN management system.

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